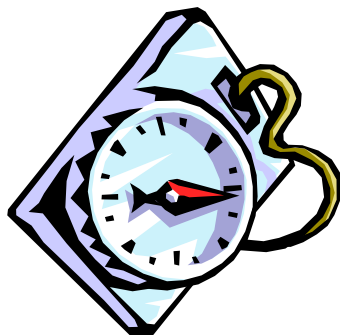


Compass Crusade



In a Nutshell



As students learn how to follow a designated course using a map and compass, they discover how biologists use orienteering in the process of studying plants and animals.

Grades	5-6
Seasons	Fall, Winter, Spring
Location	Visitor Center

Learning Objectives:

After participating in this activity, students will be able to:

- Properly operate a compass.
- Demonstrate how to use a map and compass to navigate between selected points.
- Give at least one way a biologist might use a compass to collect data.

Literature Connections

Me On the Map by Joan Sweeny (280L)

As the Crow Flies: A First Book of Maps by Gail Hartman (320L)

Pre-Activities

Students will learn parts of a compass and how to set and follow a bearing. Using measurement and applied math students will also learn to calculate their pacing.

On-site Activities

Students will practice what they learned in the classroom on a refuge orienteering course. They will discover how map and compass skills were important in the past and how biologists use them today to help in the scientific research of plants and animals.



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Classroom Connection

Reading a Road Map

Using a map and map key, calculate the distance student distance traveled by bus from their school to the refuge.

Calculate Hiking Distance

Have students calculate the distance they traveled on the course at the refuge using their recorded number of paces (completed during the pre-activity).

- Have the students add up all their paces from start to finish of the orienteering course. Take the total number of paces and multiply it by each student's individual pace length (not the class average).

For example, a student walked 210 paces and their feet per pace is 5.

$$210 \times 5 = 1050 \text{ feet traveled}$$

Create a Schoolyard Course

Have students create a schoolyard orienteering course using their new skills.

Topo Map Challenge

Introduce students to topographical map reading. Ask students to design the easiest (hardest or shortest) route from one designated point to another by reading the contour lines on the map.

Teacher Resources

Be Expert with Map and Compass: The Complete Orienteering Handbook by Bjorn Kjellstrom



Compass Crusade Pre-activity

Materials

- Classroom Set of Compasses
- Compass Instructional Model
- Sheet of White Butcher Paper for the K-W-L Chart
- Markers
- Tape reel
- Masking Tape
- Student Calculators (optional)

Introduction

Use the K-W-L model to introduce orienteering. On the board, make three columns. In the first column list students' Knowledge about navigation. In the second column list what students Want to know about compasses. In the third column, write the header Learned, and write the list at the end of the field trip.

Under the first column have the students share what they know about navigation and define the following vocabulary words if students do not mention them.

- **Navigate:** The process of determining and applying the appropriate skills, techniques and route choices to travel from one point to another.
- **Orienteering:** use of a map and compass to navigate between waypoints along an unfamiliar course; a competitive outdoor activity using a detailed topographic map and a compass to navigate through the terrain and find a series of natural or man-made features indicated on the map; the act of navigating through terrain.
- **Compass:** a device for determining directions by means of a magnetic needle or group of needles turning freely on a pivot and pointing to the magnetic north; navigational tool.
- **Cardinal Points:** one of the four principal compass points north, south, east, and west.

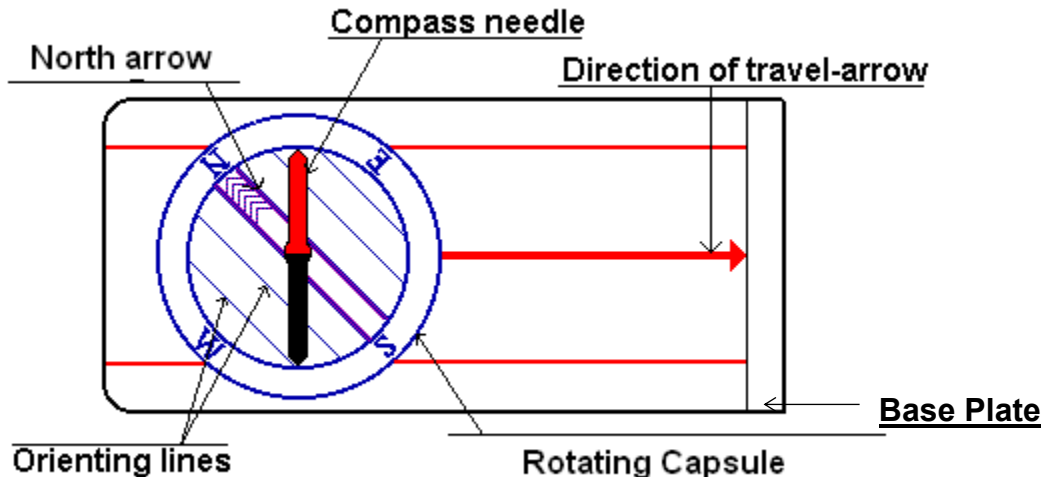
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- **Inter-cardinal Points:** one of four secondary compass points NW, SW, SE, and NE.
- **Degree (Azimuth or Bearing):** the numeric degree indicating direction of travel on a compass.
- **Pacing:** any of various units of distance based on the length of a human step.
- **Waypoint:** an intermediate point on a route or line of travel; designated locations of interest you want to remember.

Once these terms have been defined, explain to the class that they will be orienteering their way around the Refuge using compasses on a designated course. In order to complete the course, they need to know how to properly use a compass and calculate pacing.

How to Read a Bearing

Ask the students to fill in the second column of what they WANT to know about using a map and compass. Pass out one compass to each student. Using the large compass instruction model, demonstrate how to use each part of the compass in the order described below.



- **Base Plate:** This is the flat area of the compass that rests in the flat palm of your hand. The straight end, not the curved end attached to the neck strap, should always point away from you.
- **Direction of Travel-Arrow:** Located on the base plate, this red arrow outline should always point away from you as you hold the

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base plate in the palm of your hand. If the direction arrow points toward you as you hold the compass, you are holding it backward.

- **Rotating Capsule:** This round, movable ring is marked with the 4 cardinal directions and degrees from 0 to 360.
 1. Have the students locate the cardinal points (N, S, E, W) on the rotating capsule. Ask students to rotate the capsule until they have lined up the N in the direction arrow.
 2. Next, ask them to turn the capsule until they've lined up 60 degrees in the direction arrow.
 3. Have them continue to rotate the capsule to your directions. Ask them to observe the needle in the middle of the capsule. Does the red-end of the needle point to a different direction as they rotate the capsule? (No, the red end of the needle is magnetized and will always point north.)
- **Magnetic Needle:** This half-red and half-black needle is magnetized and rotates within the capsule. The red magnetized end always points toward north.
- **North Arrow:** This red arrow outline inside the rotating capsule helps users determine their proper direction of travel. The red magnetic end of the compass needle (often referred to as FRED) should line up inside the north arrow outline (referred to as the SHED) when determining the direction of travel. By putting Red Fred in the Shed the user is moving a compass bearing in a determined degree from north.
 1. Have students turn the capsule to a bearing of 30 degrees in the direction of travel arrow.
 2. Now orient the compass to north by turning your **WHOLE** body (with the compass in the flat of your hand) until the magnetic needle lines up inside the north arrow outline (found inside the capsule).
 3. Now point in the direction of travel (follow the Direction of Travel arrow located on the base plate.)

Practice a couple of bearings with the students to make sure everyone can orient themselves and use the compass properly.

Pacing

Another part of navigation and orienteering is to know how far to travel. The international mode of travel is called pacing. Pacing is counting every other step over a distance of 100 feet. The major factor is consistency and accuracy. Demonstrate pacing by walking around the classroom. To count paces, slap your hand on the left leg each time you take a step with that foot; this is one pace. Will each person's pacing be the same? Not always. Differences in stride span, speed, and topography will affect pacing.

Mark out 50 feet down a hallway using masking tape for the starting and ending point. Have the students count their pacing down and back. Use this number as their pace for 100 feet. Have the students record this number to use on their fieldtrip. See an example below for calculations.

Average 100ft Pace: 18 paces + 19 paces = 37 paces

Calculate the class average to use during the field trip portion of this activity. ***Write this down on the pre-activity reservation sheet for the refuge staff that will lead the field trip.**

Wrap-Up

Let students know that they will complete the third column of the K-W-L chart at the Refuge after their field trip. Remind them that they will be following a set of bearings to find multiple waypoints along and orientation trail during their field trip. They will be walking over uneven terrain and possibly through tall grass. Encourage them to wear long pants, long sleeves and sturdy shoes.

***Make sure to bring the KWL chart along on their fieldtrip to complete at the conclusion of their map and compass route.**

Compass Crusade On-site Activities

Materials

- Calculators (unless the teachers do not want them using calculators to do simple adding and dividing)
- Classroom Set of Compasses
- Compass Instructional Model
- Small stick or flagging – 1 per student (or team)
- Orienteering Course Sheets- 1 course per group
- Trail Map with starts designated per group
- Clipboards- 1 per group
- Pencils – 1 per group
- Whistle
- Marschner Map
- Lewis and Clark Map

Introduction

Amphitheater/Inside Visitor Center (20 minutes)

How is pacing important?

Pacing was one of the ways maps were made as land was explored and split between states in the early development of our country.

Lewis and Clark

Display the Lewis and Clark map as you describe the expedition.

The famous exploration team Lewis and Clark drew a map of the west as they explored the new territory acquired in the Louisiana Purchase of 1803. It was very important to the President, at that time Thomas Jefferson, that this new land be mapped. President Jefferson was looking for an easy river route that would allow for easy trade with the Orient. He hired Meriwether Lewis to head the expedition into the unknown lands in search of this route.

Captain Lewis hired William Clark as the co-leader of the expedition. Captain Clark was an experienced mapper. He took constant compass readings throughout the expedition. He took bearing at every curve

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in every river they canoed and at every bend in the mountains they climbed.

Captain Clark was also skilled at dead reckoning, the art of calculating travel distance. By knowing his pace, the speed at which the boats and horses traveled, and by using the night stars to determine his latitude and longitude, he could calculate how far they traveled each day.

In the end, Captain Clark produced a detailed, accurate map of the new land from the mouth of the Missouri River in St. Louis, all the way to the Pacific Ocean in Washington State.

With only a compass, pacing, and the stars, the new land known as the Louisiana Purchase was successfully mapped. Captain Clark calculated the crew of the expedition had travelled 4,162 miles, which we know today was only 40 miles from the true distance!

Marschner Map of the Original Vegetation of Minnesota

This famous and valuable map was drawn by a man who had never set foot in Minnesota! The map that biologist, foresters, and environmental engineers use today is based on the writings of the early surveyors of the Public Land Survey (1847-1907). These surveyors painstakingly walked through the state, with paper, pencil and compass, making detailed written records of the locations, types and sizes of the plant communities they found. From these writings, Francis Marschner, who worked in Washington, D.C. for the U.S. Bureau of Agricultural Economics, created a map that outlines the original habitats of Minnesota: once wet prairie, oak openings, Big Woods, mixed hardwood, or any of a dozen other vegetative types long lost to 19th- and 20th-century human development.

Today, pacing provides a way of estimating distance between waypoints. Pacing can also be converted into an estimate of the time needed to travel between two waypoints. This is very important information for planning hiking and canoeing trips. Without an idea of how far you've gone (or still need to go) and the time needed to get there, you might be

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caught on the trail or water after dark. You might also plan a segment of travel that is more than you physically can, should, or want to do.

Calculating Pacing for the Orientation Course

Before students follow the compass course, they must determine pacing (using the Class average) between each waypoint. To explain this series of calculations start by instructing each team to round the distance between each waypoint to the nearest 100 feet. Then students must divide this distance by 100. Finally, students must multiply their pacing by the (multiples of 100) feet they are traveling between waypoints. Share the example calculation below to help clarify the math. Have students complete the pacing estimates for the distances between each waypoint on their team's compass route.

Example Calculation:

- **Distance from Waypoint A to B**
480 feet rounded to nearest hundred = 500 feet
- **Increments of 100 feet**
 $500\text{feet} / 100\text{feet} = 5 \text{ increments}$
- **Student (class average) Pacing for the Distance between Waypoints**
 $5 \text{ (increments of 100 feet)} \times 15 \text{ (student's pacing)} = 75 \text{ paces}$

Ask group leaders to hold onto the team's compass route through the triangle route activity next.

Outside Activities

On refuge, (90 minutes)

Triangle Route

Using the large compass instructional model, review the parts of a compass and how each piece works. Take the group outside to practice finding and following a bearing.

Give each student a flag marker. In a large open area outside ask student to spread apart and mark their location by sticking the flag in

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the ground by their feet. Now call out the following set of instructions one at a time.

1. Set the compasses to north (360 degrees).
2. Pick out a "sight" in the line of the direction of travel arrow. The sight can be a tree, a telephone pole, or anything easily visible.
Sighting is an orienteering method that involves selecting an object ahead in your direction of travel, quickly moving to it, then selecting another object ahead and so forth. Sighting eliminates the need to constantly glance at your compass as you walk.
3. Take 20 paces (or any number of paces as long as they are always the same) toward their sight and then stop.
4. Re-set the compasses to 120 degrees. Select a new sight.
5. Take 20 paces in this new direction and stop.
6. Direct students for a third time to re-set their compasses, this time to 240 degrees, and again take 20 paces following the direction of travel arrow.
7. At this point students should find themselves fairly close to the flag marker where they started.

Orienteering Course

Introduce some additional orienteering vocabulary as students follow along on their map.

- **Course** – A series of circles or triangles on the map which indicate the control markers to be visited, or the route in the terrain between the control markers.
- **Route** – The actual line of travel taken on a course.

There are 8 designated team courses for Bloomington and 6 for Rapids Lake. The course is marked with numbered blue tags. **Courses and waypoints may overlap. For this reason, it is important that student**

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carefully sight and pace to avoid accidentally ending up on another (or non-existent) route.

Encourage groups to walk from waypoint to waypoint carefully re-checking their bearing often to ensure success. If a team cannot find a waypoint marker, instruct them to return to their last waypoint and try again.

Remind students of the following before they begin the compass course:

- Paces are just an estimate of distance. You might fall short of your waypoint or pass it by several feet. Keep your eyes open for the waypoint marker as you get within 10 feet of your pace estimate.
- Going up, down, and across hills as well as through deep grass, over sand, through brush, and over rocks will all have an effect on shortening or lengthening your pace.
- Wearing a backpack and carrying a water bottle shortens your pace.
- Losing count of your paces means you have to go back to your last waypoint and start over.

Divide students into course teams, with at least 1 adult chaperone per group. Assign each team to a course. **Assist them to correctly dial in their first bearing, turn in the correct direction of travel, and correctly orient their map on their way to the first marker.**

If time runs out before all groups complete their course blow the whistle to end the activity and gather the teams for the wrap up discussion. If there is enough time, let students trade course maps and try navigating through more than one route.

Wrap-Up Management Connection- Wildlife Studies

Amphitheater/Inside Visitor Center (5 minutes)

Using the K-W-L chart, ask the students what they learned from this activity? Record their answers under the learned column on the chart.

- Ask students how biologists might use a compass? *Biologists often need to collect data from a specific location. Using a map and*

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compass or a GPS enables them to return to the same location repeatedly for more collection. This ensures that the data collected is accurate and concise. These qualities are important in convincing other biologists that the information gathered from the research is true.

- *What advantages might there be to using a compass rather than a GPS? In truly remote areas a GPS signal might not be available or reliable. Compasses are much cheaper and in some cases easier to use. Compasses do not rely on a battery.*